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W. RUPP, 117 Pearl St., New York.

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A. A. BRENEMAN, 97 Water St., New York.

PROCEEDINGS OF THE AMERICAN CHEMICAL SOCIETY.

REGULAR MEETING, held November 5th, 1886.

Vice-President Breneman in the chair.

The minutes of the meeting of June 4th were read and approved.

The minutes of the meeting of the Board of Directors of July 23d were read.

The following gentlemen were elected members:

I. Wyman Drummond, Ph. D., 436 West 22d street, New York City.

Mr. W. J. Williams, Keystone Chemical Co.'s Works, Camden, New Jersey.

Dr. Malcolm Leal, 154 West 34th street, New York City.

Mr. Joseph F. Geisler, Mercantile Exchange, New York City.

Mr. Jonathan Cawley, 278 Passaic street, Newark, New Jersey.

Mr. Charles H. Preston, Danvers, Mass.

Prof. M. A. Scovell, Lexington, Kentucky.

Dr. Robert Schupphans, American Zylonite Co., Adams, Mass.

The following names were proposed for membership:

Mr. Durand Woodman, 494 Broad street, Newark, New Jersey.

Mr. Curtis C. Howard, 99 Jefferson avenue, Columbus, Ohio.

Messrs. Casamajor, Breneman and Endemann were elected as the Committee for nominating Officers for 1887.

The following papers were then read:

On the necessity of Standard Conditions in the Application of the Wanklyn Process for Water Analysis; Prof. A. A. Breneman.

On the Action of Hydrofluoric Acid on Silica and Silicates; J. B. Mackintosh.

Prof. W. P. Mason exhibited samples of brass tubing which had been used as experimental boilers, to show the nature of the rupture in boiler explosions.

The meeting was then adjourned.

C. E. MUNSELL,
Recording Secretary.

ON THE ACTION OF HYDROFLUORIC ACID ON SILICA AND SILICATES.

By J. B. MACKINTOSH.

In a preliminary note on this subject, published in July, 1886,* I called attention to the great difference in the behavior of quartz and opal, when submitted to the action of hydrofluoric acid, and gave a general indication of the behavior of silicates under similar circumstances. The few data contained in the above mentioned note will be all included in the present paper, which I hope may be regarded as an acceptable contribution to the literature of the silicates.

The starting point of the present investigation arose from a question which occasionally presented itself in the course of my professional work. I have frequently been appealed to to decide upon the identity of cut and polished gems, without, of course, subjecting them to injury in any way. Chemical analysis being out of the question, it is necessary to make the determination by means of the physical characteristics alone, but in certain cases it becomes a very difficult matter to decide. The two gems, garnet and spinel, occurring in varying shades of color, although generally readily distinguished, yet occasionally approach so closely in their characteristics that I attempted to find a means of differentiation based on their chemical constitution, which, while it would have the certainty of a qualitative analysis, would leave the gem practically uninjured. Spinel being a compound of protoxide with a sesquioxide in equal molecular proportions, while garnet is a silicate which may be regarded as derived from spinel by the substitution of an equivalent amount of silica for two-thirds of the sesquioxide present, it seemed probable that hydrofluoric acid would furnish the means of differentiation sought for, but on making the experiment it was found that neither mineral was attacked in the slightest degree. This unexpected result was so interesting that I determined to extend the investigation further than I had originally purposed and to examine in this way the principal silicates occurring in nature.

* School of Mines Quarterly, No. 4, Vol. 7.

The following tables show the results of the qualitative experiments I have made. I have included in these tables the atomic formulæ, the specific gravity, the unit volume and the percentage of silica in the mineral. For the first three data I am indebted to Dr. T. Sterry Hunt and have taken most of them from his recently published essay on "A Natural System of Mineralogy, with a classification of Native Silicates." *

The atomic formulæ are those employed by Sterry Hunt and differ from ordinary formulæ, in that the quantities represented by the symbols of the elements are all equivalent to one atom of hydrogen. The coefficients thus represent the oxygen ratios of the constituents, and the formulæ are very much simplified.

I.—MINERALS WHICH ARE VISIBLY ETCHED BY HYDROFLUORIC ACID.

	Atomic Formula.	Sp. Gr.	Volume	% SiO_2.	Remarks.
Quartz	$si_1\ o_1$	2.67	5.62	100.	very slightly attacked.
Opal	$si_1\ o_1$	2.2	6.81	100. ?	H_2O regarded as non-essential.
Petalite	$(li_1\ al_4\ si_{20})\ o_{35}$	2.42	6.33	78.	
Wollastonite	$(ca_1\ si_2)\ o_3$	2.92	6.62	51.7	
Rhodonite	$(mn_1\ si_2)\ o_3$	3.63	6.06	46.7	
Tremolite	$((mg^3/_4\ ca^1/_4)\ si_2)\ o_3$	2.97	5.88	57.4	very slightly attacked.
Willemite	$(zn_1\ si_1)\ o_2$	4.18	6.63	27.5	
Chrysolite	$(mg_1\ si_1)\ o_2$	3.40	5.38	45.	
Fayalite	$(fe_1\ si_1)\ o_2$	4.35	5.86	27.3	very slightly attacked.
Wernerite	$(m_4\ al_9\ si_{16})\ o_{39}$	2.70	6.44	48.5	
Vesuvianite	$(ca_3\ al_2\ si_3)\ o_{10}$	3.40	5.67	37.	very slightly attacked.
Biotite	$(mg_4\ al_4\ si_3)\ o_{16}$	3.00	6.06	41.	very slightly attacked.
Phlogopite	$(mg_4\ al_2\ si_3)\ o_{12}$	2.85	6.35	40.	very slightly attacked.
Iolite	$((mg^2/_3\ fe^1/_3)\ al_3\ si_5)\ o_9$	2.67	6.31	49.	
Albite	$(na_1\ al_3\ si_{12})\ o_{16}$	2.62	6.24	68.6	
Orthoclase	$(k_1\ al_3\ si_{12})\ o_{16}$	2.54	6.83	64.6	
Oligoclase	$((na^3/_4\ ca^1/_4)\ al_3\ si_9)\ o_{12}$	2.65	6.27	61.5	
Labradorite	$((ca^3/_4\ na^1/_4)\ al_3\ si_5)\ o_{10}$	2.70	6.28	55.5	
Leucite	$(k_1\ al_2\ si_5)\ o_{12}$	2.56	7.09	55.	
Titanite	$(ca_1\ si_2\ ti_2)\ o_5$	3.50	5.65	30.5	
Datolite	$(ca_2\ si_4\ b_2\ h_1)\ o_{10}$	2.99	5.35	37.5	very slightly attacked.
Apophyllite	$(ca_1\ si_4)\ o_5 + 2\ aq$	2.35	6.44	53.	
Pectolite	$(ca_5\ si_{12})\ o_{17} + 1\ aq$	2.78	6.57	54.6	
Calamine	$(zn_1\ si_1)\ o_2 + ½\ aq$	3.50	6.87	25.	
Prehnite	$(ca_2\ al_2\ si_3)\ o_{11} + 1\ aq$	2.95	5.64	43.6	etched with difficulty.
Heulandite	$(ca_1\ al_2\ si_{12})\ o_{16} + 5\ aq$	2.20	6.58	59.	
Stilbite	$(ca_1\ al_2\ si_{12})\ o_{16} + 6\ aq$	2.20	6.46	57.4	
Harmatome	$(ba_1\ al_2\ si_{10})\ o_{16} + 5\ aq$	2.45	6.82	46.5	
Chabazite	$(ca_1\ al_2\ si_3)\ o_{12} + 6\ aq$	2.19	6.41	52.2	
Analcite	$(na_1\ al_2\ si_3)\ o_{12} + 2\ aq$	2.29	6.86	54.5	
Natrolite	$(na_1\ al_2\ si_3)\ o_{10} + 2\ aq$	2.25	7.03	47.3	
Serpentine	$(mg_3\ si_4)\ o_7 + 2\ aq$	2.53	5.78	42.	
Halloysite	$(al_2\ si_4)\ o_7 + 3\ aq$	2.40	5.75	43.3	
Jeffriesite	$(m^{II}_5\ al_6\ fe^{III}_2\ si_{15})\ o_{30} + 7½\ aq$	2.30	6.50	34.	

* This essay forms pp. 279-401 of his Mineral Physiology and Physiography. 1886, S. E. Cassino, Boston, Mass.

II.—MINERALS WHICH ARE NOT VISIBLY ETCHED BY HYDROFLUORIC ACID.

	Atomic Formula.	Sp. Gr.	Volume	% SiO_2.	Remarks.
Quartz.	$si_1 o_1$	2.67	5.62	100.	some varieties.
Enstatite	$(mg_1 si_2) o_3$	3.10	5.54	60.	
Diopside	$((mg\ ca)_1 si_2) o_3$	3.28	5.48	54.	
Spodumene	$(li_1 al_4 si_{10}) o_{15}$	3.18	4.88	64.	
Beryl.	$(be_3 al_2 si_{12}) o_{18}$	2.70	5.52	67.	
Tremolite	$(mg^3/_4\ ca^1/_4\ si_2) o_3$	2.97	5.88	57.4	slightly attacked by long exposure.
Zircon	$(zr_1 si_1) o_2$	4.70	4.84	33.	
Garnet	$(ca_3 al_1 si_2) o_4$	3.50	5.37	36.	
Epidote	$(ca_1 al^4/_3 fi^2/_3 si_3) o_8 + 1/_3$ aq.	3.40	5.40	38.	
Zoisite	$(ca_1 al_3 si_3) o_8$	3.35	5.32	44.	
Axinite	$(ca_1 al^4/_3 fi^2/_3 b^1/_3 si_2{}^1/_3) o_7$	3.27	5.53	44.	
Danburite	$(ca_1 b_2 si_4) o_8$	3.00	5.12	48.	
Lepidolite	$(m_1 al_4{}^1/_3 si_3) o_{12}{}^1/_3$	3.00	5 61	46.5	
Muscovite	$(k_1 al_3 si_3) o_{12}$	3.12	5.68	46.5	
Biotite	$(m_4 (al\ fe)_4 si_3) o_{16}$	3.00	6.06	41.	very slightly attacked.
Phlogopite	$(m_4 al_2 si_3) o_{12}$	2.85	6.35	40.	very slightly attacked.
Fayalite	$(fe_1 si_1) o_2$	4.35	5.86	27.3	very slightly attacked.
Tourmaline	$(m_1 al_3 si_3) o_9$	3.05	5.36	37.5	
Andalusite	$(al_3 si_2) o_5$	3.35	4.83	37.5	
Cyanite	$(al_3 si_2) o_5$	3.66	4.42	37.5	
Topaz	$(al_3 si_2) o_4 f_1$	3.65	5.04	34.	
Datolite	$(ca_2 si_4 b_2) o_9 + 1$ aq.	2.99	5.35	37.5	forms coating of $Ca F_2$.
Prehnite	$(ca_2 a^1{}_3 si_3) o_{12} + 1$ aq.	2.95	5.64	43.6	slightly attacked.
Talc	$(mg_4 si_{10}) o_{14} + 1$ aq.	2.60	6.07	62.8	
Ripidolite	$(mg_5 al_2 si_3) o_{14} + 4$ aq.	2.70	5.70	31.3	
Margarite	$(ca_1 al_3 si_4) o_{11} + 1$ aq.	2.99	5.54	30.	

To the above may also be added the non-silicate species corundum, spinel, and chrysoberyl, which are not attacked, and the artificial product glass, which is.

I have included in both classes several species which seem to be on the border line, and which sometimes seem to be unattacked, while at other times, by longer exposure or by treatment of a different surface, a slight action becomes evident. Thus with vesuvianite the prismatic faces of a crystal showed no etching, while the basal plane of the same crystal was perceptibly attacked; this, however, might have been due to a difference in the time of exposure, though in other cases, as in quartz, it is undoubtedly the fact that some surfaces are not attacked as readily as others.

By inspection of the data given it will be seen that the amount of silica present does not determine the action of the acid, nor does the molecular ratio of silica to the bases, but we see that the volumes show a very decided difference. In the non-attacked species the volume for the greater number is considerably below 6, while in the non-resisting species it is generally considerably above this figure. Thus comparing enstatite and diopside with wollastonite and tremolite, we have in the first two the volumes of 5.54 and 5.48, in the less dense wollastonite the volume is 6.62, while

the tremolite has an intermediate volume of 5.88, and it is likewise intermediate in its relation to the acid. These four minerals differ in composition mainly by the gradual substitution of lime for magnesia, the ratio of bases to silica remaining unchanged. It is possible that the nature of the base may have a considerable effect on the extent of condensation of the molecule. In the above instances the replacement of magnesia by lime seems to tend to increase the volume and diminish the power of resistance to HF.

At the suggestion of Dr. T. Sterry Hunt, while carrying on these qualitative tests, I also proceeded to make quantitative comparisons of several minerals. I proposed to use quartz as a standard of reference, but immediately found that it was so slightly attacked that it would not do for the purpose.

In these experiments the minerals were reduced to an average size of 3-100 cubic millimeter by careful sizing, and one grm. of each sample was taken for each experiment. The samples were all treated for one hour with an excess of dilute hydrofluoric acid (9%), at the ordinary temperature of the laboratory, all conditions being, as far as possible, the same. At the expiration of that time the acid was poured off, the residues carefully washed and dried, and where any insoluble fluorides or products resulting from the decomposition of the mineral were present they were removed by the use of a fine bolting cloth before weighing the residue of unattacked mineral. The results obtained are given in the following table, which also shows the atomic formula, the density, the volume, and the % SiO_2 for each mineral.

QUANTITATIVE RESULTS.

	Atomic Formula.	Sp. Gr.	Volume.	% SiO_2	% Dissolved.	
Quartz	$si_1 o_1$	2.67	5.62	100	1.56	
Tremolite	$(mg_{\frac{3}{4}} ca_{\frac{1}{4}} si_2) o_3$	2.97	5.88	57.4	2.47	Governeur, N. Y.
Augite		3.30	....	....	2.61	Note 1.
Hornblende		3.21	....	....	2.64	Note 1.
Chrysolite	$(mg_1 si_1) o_2$	3.40	5.38	45.	5.40	
Prehnite	$(ca_2 al_2 si_3) o_{11}+1$ aq	2.95	5.64	43.6	8.59	Paterson, N. J.
Albite	$(na_1 al_2 si_{12}) o_{16}$	2.62	6.24	68.6	23.1	
Labradorite	$(ca_{\frac{3}{4}} na_{\frac{1}{4}} al_2 si_2) o_{10}$	2.70	6.28	55.5	24.65	Note 2.
Petalite	$(li_1 al_4 si_{20}) o_{35}$	2.42	6.33	78.	28.97	Sweden.
Oligoclase	$((h\,ca)_{\frac{1}{4}} na_{\frac{3}{4}} al_2 si_{10}) o_{14}$	2.61	6.41	64.26	35.25	Haddam, Ct.
Orthoclase	$(k_1 al_2 si_{12}) o_{16}$	2.54	6.83	64.6	43.45	Pike's Peak, Colorado
Iolite	$(mg_{\frac{2}{3}} fe_{\frac{1}{3}} al_2 si_5) o_9$	2.67	6.31	49.	47.34	Finland, Note 3.
Oligoclase	$(na_{\frac{3}{4}} ca_{\frac{1}{4}} al_2 si_9) o_{13}$	2.65	6.27	61.5	50 83	Sweden.
Nephrite		....	....	....	61.59	Easton, Pa., Note 4.
Leucite	$(k_1 al_2 si_8) o_{12}$	2.56	7.09	55.	66.30	
Rhodonite	$(mn_1 si_1) o_3$	3.63	6.06	46.7	69.21	Franklin, N. J.
Opal	$si_1 o_1$	2.2	6.81	100.	77.28	
Serpentine	$(mg_3 si_1) o_4+2$ aq	2.53	5.78	42.	80.67	
Halloysite	$(al_2 si_1) o_4$	2.40	5.75	43.3	100.0	Lookout, Ala., Note 5.
Willemite	$(zn_1 si_1) o_2$	4.18	6.63	27.5	100.0	Franklin, N. J.

Two samples of willemite were also treated for 15 minutes with the following results :

Green Willemite, massive	86.78
Brown " crystallized (Troostite)	92.09

NOTE 1.—These samples of augite and hornblende are from Teplitz, Bohemia. I have not their analysis.

NOTE 2.—The surfaces of the grains were coated with a white incrustation, probably of calcium fluoride, which would both retard the action of the acid and make the apparent amount dissolved less than the truth ; both causes of error acting in the same direction.

NOTE 3.—A fine powder insoluble in HF was formed—either an insoluble fluoride or an included mineral.

NOTE 4.—This so-called nephrite, said to be a variety of amphibole, is from Easton, Pa. Dana says it is a mixture of minerals. The result I have obtained shows that it is certainly not amphibole, nor does it contain much, if any, of that species.

NOTE 5.—This disintegrated with great rapidity, but left an insoluble residue behind, either an insoluble product of the reaction or an included mineral.

Now, on comparing together minerals of like formula in this table, we see that the one with least volume is likewise least attacked by the acid, for instance, quartz and opal, tremolite and rhodonite, chrysolite and willemite, albite and orthoclase. Taking together the different felspars and minerals of analogous composition, although they are not strictly comparable on account of the variation in the amount of silica, we have the following series in the order of solubility : albite, labradorite, petalite, oligoclase, orthoclase, oligoclase, leucite ; which, with the exception of the second oligoclase, is also the order of increase of volume. It is, of course, to be expected that variations in composition will have a great influence in modifying the action of the acid, but oligoclase seems to be exceptional, as it is intermediate in composition between albite and labradorite, and we should expect its solubility to be between them also.

The oligoclase which gave me a solubility of 50.83% was from a Swedish locality, but I could not obtain its analysis. On account of the discrepancy in this result, when compared with what we should expect, I obtained from Prof. B. W. Frazier, of Lehigh

University, a sample of oligoclase from Haddam, Conn. (the first one in the table), which gave a solubility of 35.25%, a specific gravity of 2.61, and a volume of 6.41. The analysis of oligoclase from this locality (Dana's System, p. 347), leads to an atomic formula differing slightly from that given by Dr. Hunt, but agreeing with that given by Dana. This result takes its place in the proper order according to volume and, I think, leaves no doubt that the volume accorded to the 50.83% oligoclase is erroneous. This experiment was made at a different time and under slightly different conditions, so that the solubility found is probably rather less than it should be.

To further illustrate the subject, I obtained a sample of slag from an iron cupola furnace, the outside portion being vitreous from sudden cooling while the interior was opaque and crystalline. The composition of the two portions being presumably the same, as the piece chosen was but the size of the first, any variation in solubility could only be ascribed to the molecular condition and not to any difference of composition. The crystalline portion was very porous, it having an apparent specific gravity in the lump of 2.34, but on pulverizing finely, though not to an impalpable powder, the density rose to 2.97. The vitreous portion changed less, from 2.77 in lump to 2.81 in powder.

The results obtained for solubility in 9% acid were:

	Sp. Gr.	Volume ratio.	Per cent. dissolved.
Vitreous slag	2.81	1.057	68.80
Crystalline slag	2.97	1.	9.60

This result also agrees perfectly with what might be expected.

M. W. Iles, in a paper on "The Decomposition and Analysis of Slags,"* describes a method of obtaining samples of slags for analytical purposes by chilling the melted slag suddenly, thus obtaining a vitreous sample which is readily soluble in dilute hydrochloric acid; while if allowed to cool and become crystalline, it is not attacked by the acid. This is a practical application of the law of increase of solubility with increase of volume set forth

* School of Mines Quarterly, Vol. 5, p. 351.

by Sterry Hunt in 1863, when he asserted, in comparing the silicates meionite and zoisite, that "the augmentation of hardness, of density and of chemical indifference which is seen in this last species is doubtless to be ascribed to a more elevated equivalent; or, in other words, to a more condensed molecule." Again, in 1867, he wrote, after naming a number of groups of related minerals: "The hardness of these isomeric or allotropic species, and their indifference to chemical reagents, increases with their condensation; or, in other words, varies inversely as their empirical equivalent volumes, so that we here find a direct relation between chemical and physical properties." This is resumed in his concise statement that "in related and homologous species, the hardness and chemical indifference are inversely as the value of V (the so-called atomic volume); or in other words, that they increase with the diminution of V."* The specific gravity of solids and liquids is, according to Sterry Hunt, a function of their equivalent weights.

In order to test still further the truth of this law, I ignited several samples of the granulated quartz, used in the previous experiments, for varying periods of time, anticipating that the longer the period of ignition the greater the solubility would be, since we know that fused quartz has a lower specific gravity than the original crystal. The results were extremely satisfactory, and are as follows:

INFLUENCE OF IGNITION ON THE SOLUBILITY OF QUARTZ.

One gram of each sample treated for one hour with excess of dilute (9%) HF.

	Per cent. dissolved.	Sp. Gr.
Raw quartz	1.28–2.18	2.64
Same, ignited over Bunsen burner 30 minutes	1.61	
" " " " " 45 "	1.78	
" " " " " 75 "	1.87	
" " " " " 120 "	2.05	
" " " " " 75 " and over blast lamp 45 minutes	4.23	2.62
" " " blast lamp 120 "	2.79	
" " " " " 210 "	5.35	
Fused quartz	11.02	2.22

* Comptes Rendus de l'Académie des Science, lvi., 1256; Hunt's Chemical and Geological Essays, pp. 446, 457; and Mineral Physiology and Physiography, p. 304.

I obtained the sample of fused quartz through the kindness of Dr. T. Sterry Hunt, who prepared it in the electrical furnace of the Messrs. Cowles, at Cleveland, September 1st, 1885.* The sample used was reduced to the same size as in the other experiments and, in that form, had a specific gravity of 2.22. It was treated with the dilute acid for an hour and a quarter, a sample of ordinary quartz being simultaneously treated for comparison. In that time it had lost 13.77%, against 2.13% for the raw quartz. In the table I have deducted one-fifth these amounts, so as to give the solubility in one hour, which permits direct comparison with the other determinations. The solubility of the raw quartz varies in different determinations; I have in all obtained the following values: 1.28, 1.56, 1.70, 1.70, 2.18. The last figure is probably too high—from mechanical loss.

Although the temperature of ignition is far too low to effect fusion, the results show that a molecular change has commenced towards the less dense and more easily soluble form of silica. In this connection, I attempted to prepare some artificial tridymite by the fusion of amorphous silica with sodium metaphosphate and obtained thin plates which were readily soluble in the acid. I had not enough material to make other than the one test, and only surmise that it really was tridymite, though probably an impure sample.

The action of quartz being so interesting, I made several experiments on whole crystals of different crystalline modifications from three localities, in order to ascertain the quantitative differences between them, since I had noticed in my qualitative tests that some quartz crystals did not show any appreciable etching action. As in these cases the amount of action depends on the surface exposed, I have measured the area of the exposed faces, protecting broken surfaces and certain faces, with wax, unless otherwise mentioned.

* Transactions American Institute of Mining Engineers, Vol. XIV., p. 492.

TREATED FOR ONE HOUR IN 9 PER CENT. HYDROFLUORIC ACID.

	Locality.	Weight. Grams.	Amount Dissolved.		Area of Faces. Square Centimeters.	Amount Dissolved per Square Centimeter. Grms.	Remarks.
			Total.	Per Cent.			
Quartz Crystal.	Herkimer, N Y..	0.5742	0.0002	0.035	1.5	0.000133	Not visibly etched.
Opal.....	....	0.4005	0.1140	28.46	1.5	0.076	Approximately same size.

With opal, the figure given as expressing the amount dissolved per square centimeter is necessarily lower than the truth, as the area of the exposed surface diminishes as the solvent action progresses. In the present case, the area at the end of the experiment is only about 80 per cent. of the area at the commencement, so that the loss per square centimeter will be somewhere between 0.095 and the figure given. The quartz crystal was without flaw, and was exposed on all faces; it did not show the slightest dimming of its brilliancy, and were it not for other experiments, it would be difficult to believe that the loss observed was not due to errors of experiment solely.

CRYSTALS OF QUARTZ.

Treated for 1 hour in Concentrated (54 per cent.) HF.

Locality.	Weight. Grams.	Amount Dissolved.		Area of Faces. Sq. Cm.	Amount Dissolved per Sq. Cm. Grms.	Remarks.
		Total.	Per Cent.			
Herkimer, N. Y.....	0.9733	0.0004	0.041	2.2	0.000182	Not visibly etched, perfect crystal, completely exposed.
White Plains, N. C...	0.6805	0.0016	0.235	.....	.....	Visibly etched, fractured surface also exposed.
White Plains, N. C...	6.5827	0.0024	0.036	7.2	0.000333	Visibly etched, acute rhombohedral faces exposed.
Hot Springs, Ark.....	22.0087	0.0050	0.023	11.9	0.000446	Visibly etched, prismatic faces exposed.

These figures show a quite decided, though small, difference of susceptibility in the crystals from different localities. In the first "White Plains, N. C.," specimen, the amount dissolved was

relatively larger than in any of the others, but this is due to the exposure of the fractured surface, which is far more readily attacked than the natural faces, as the following experiments will show:

ACTION ON POLISHED SECTIONS OF QUARTZ CUT PERPENDICULARLY TO THE AXIS OF THE CRYSTAL.

Treated for 1 hour in 54 per cent. HF.

Total Area Exposed. Square Centimeters.	Weight. Grams.	Amount Dissolved.		Amount Dissolved per Square Cm. Grms.
		Total.	Per Cent.	
13.73	2.5242	0.0575	2.28	0.0042
15.24	2.2259	0.0778	3.49	0.0051
12.46	6.3890	0.0540	0.84	0.0043

In the last case, the natural faces of the crystal formed the sides of the section, and, if we exclude them from our calculations, the area of the *cut* surfaces will be 8.46 sq. cm., and the amount dissolved per square centimeter of cut surface will be 0.0064. Here we see that the rate of attack is from 10 to 30 times greater than on the natural faces.

The etched surfaces of quartz crystals show a very peculiar variety of markings. Irregular and curved hair lines, having apparently no relation to the crystallographic form, are found in some places; the twinning structure is also developed, showing the complex nature of the crystal. On artificial surfaces of quartz, the twinning structure is made very evident. In 1852–1855, F. Leydolt* made a series of experiments on quartz and agates with hydrofluoric acid, and says: "I am led to believe * * * that agates * * * are composed of layers of different chemical constitution, or at least in a different state of aggregation. * * * Quartz crystals preserve their brilliant surface, and are not dissolved." He also says: † "The felspar is dissolved, while the quartz remains quite unaltered;" and again: "Wood opals and other quartzose stones show differences in constitution."

The action of hydrofluoric acid on different silicates has already been utilized as a means of purification, ‡ and for the proximate

* Eine neue Methode, die Achate und andere quartzhältige Mineralien naturgetreu darzustellen. Jahrb. d. K. K. geologischen Reichsanstalt, II. Jahrgang 2, S. 124.

† Loc. cit., S. 126.

‡ Treatment and Qualitative Composition of Zircon. Ed. Linnemann. Chem. News, p. 233, Vol. LII. 1885.

analysis of rocks, * but, so far as I am aware, it has only been used to separate the insoluble or difficultly soluble minerals from the readily soluble ones, with which they are associated. From the quantitative results presented in this paper, it will be readily seen how it may be applied to determine the nature of a mineral; to distinguish, for instance, between the different felspars. It would also be possible to arrive quickly at the approximate composition of a rock, of which the constituent minerals were known, such as a syenite or granite. When used in conjunction with Thoulet's solution, complex mixtures of minerals may be readily determined. I applied the acid to determine whether a specimen of cassiterite and quartz was only a mixture of the two minerals or a silicate of tin, as was claimed for it by its European label. I obtained a residue of pure SnO_2, practically the whole amount present, which in all probability, would not have been the case if it had been a compound.

Of course, the figures given in the present paper apply only to the circumstances under which the experiments were carried on; it is possible that, with a different degree of comminution, or with a different strength of acid, the rate of attack might be different, so that each investigator would need to construct a table of solubilities suited to the circumstances under which he works.

Many analytical processes have been proposed, and used, either for the decomposition of silicates by hydrofluoric acid, or for the determination of fluorine by conversion into silicon fluoride. Now, it is plain that, in the latter case, quartz is about the worst material we can introduce to furnish the necessary silica; and, in the former case, that we cannot depend on the complete decomposition of a silicate by simple treatment with hydrofluoric acid.

In conclusion, I desire to acknowledge my indebtedness to Dr. T. Sterry Hunt for many suggestions which he has made, and information given, during the course of my experiments; to Dr. T. Egleston for his kindness in furnishing me with most of the material for the investigation; and to Prof. B. W. Frazier and Mr. G. F. Kunz for assistance in procuring special specimens.

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* Minéralogie Micrographique. F. Fouqué et Michel Levy. Paris, 1879. p. 116, and Sterry Hunt, Mineral Physiology and Physiography, p. 214.

ON THE NECESSITY OF STANDARD CONDITIONS IN THE APPLICATION OF WANKLYN'S METHOD OF WATER ANALYSIS.

By A. A. Breneman, S. B.

The process of water analysis for sanitary purposes, which is commonly known as Wanklyn's method, is still, notwithstanding its admitted imperfections, more commonly used, in English-speaking countries at least, than any other. There is no process of this class which can take its place, and the question of water supply in its sanitary aspects is probably better understood to-day than it could have been without this process. As there is no immediate prospect of a better method, it is desirable that every effort should be made to eliminate its known errors and to so prescribe the conditions of its application that the results obtained by different chemists may be comparable.

By the essential principle of the process organic matter, in alkaline solution, is oxidized by a reagent which constantly varies in strength, and consequently in the temperature at which it acts. If these elements of variation are not the same in successive operations, the results are not strictly comparable. The nature of the organic matter concerned and its susceptibility to oxidation may differ widely in different analyses, and with this difference every condition of concentration, temperature, etc., will vary in its effect, that is, in respect to the quantity of ammonia disengaged in a given time, in a given number of distillates or from a given volume of liquid.

The standards fixed by Wanklyn for interpretation of the results of an analysis are valueless unless all conditions of the analysis be uniform in successive operations. To leave all questions of interpretation, and manipulation as well, to the judgment of the chemist concerned involves so large a personal equation that it may be questioned whether, in such a case, any basis for comparison of results will remain. Decision as to the relative significance of a given quantity of albuminoid ammonia must often be left to the chemist who is familiar with the circumstances under which the water was taken; but the conditions of the analysis should be so clearly defined that no room shall be left for variation in the essential features of the analytical work.

The possible errors of the Wanklyn method relate principally to the rate at which the distillation is conducted and to condensation of the distillate. The general question of loss of ammonia by imperfect condensation, has been quite fully investigated by Dr. Smart (Rep. National [U. S.] Board of Health, 1882). He has also given a few instances in which the time occupied in the collection of each distillate was noted. The writer has reported in a previous paper (this Journal, Vol. VIII., No. 1) a large number of analyses in which the time occupied in collecting each distillate was observed, and he has also called attention to the importance of this feature of the method, and suggested a definite rate as most suitable under the conditions given.

The process as described by Wanklyn takes no account at all of the rate of distillation, and the process is said to be complete when three distillates have been taken off to represent albuminoid ammonia (Wanklyn's Water Analysis, Sixth Edition, p. 40*). The extent to which the distillation is carried is also a matter which should be fixed, since it may happen in the case of dilute solutions that the ammonia evolved sinks below an appreciable amount and then rises again as increased concentration of permanganate and alkali causes more rapid evolution of ammonia.

The loss of ammonia by imperfect condensation which Smart has shown (Rep. Nat. Bd. Health, 1882, p. 251) to average 7.2% in twenty-five experiments, depends both upon time or rate of distillation and temperature of the condenser. It will also depend, although in lesser degree, upon the relative volume of retort and condenser. The loss of ammonia is insignificant when the steam is thoroughly condensed and perfect collection of ammonia requires only a relative abundance of water at a temperature sufficiently low to retain it in solution.

With respect to the possible escape of nitrogen in the form of volatile organic bases, slow distillation offers the best security against such loss by retaining these substances longer in contact with the reagent which will ultimately set free all of the nitrogen which they contain to form ammonia.

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* Subsequently (p. 50), in describing the 100 c.c. method (as a possible substitute for the method using 500 c.c.), he directs that in this case the distillates shall be collected as long as any ammonia can be found in them.

The rate of boiling, or the time occupied in distilling a given quantity of water, being so important, there can be no conformity in results unless some prescribed rate be fixed upon for general use in this process. The writer has found that the rate of ten minutes for each portion of the distillate, when 100 c.c. are taken for analysis, is easily maintained and gives in the aggregate a higher proportionate yield of ammonia than a rate which is somewhat slower. In other words, the yield of albuminoid ammonia does not continue to increase with time of distillation as rapidly above this rate as below it. This limit is found to answer well for many different waters. When 500 c.c. are taken for analysis, and 50 c.c. of distillate collected for each test, the corresponding time is twenty minutes. That the smaller volume should take less time for the evolution of a given proportion of the whole quantity of ammonia contained in it is probably to be explained by the fact that both heating surface of the retort and free surface of the liquid are greater in proportion to volume in the smaller liquid, and these conditions favor, in the latter, the disengagement of ammonia.

The volume of liquid in the retort at the beginning of the analysis, and also when the distillation of albuminoid ammonia is begun, should be the same for the corresponding stages in all analyses; if not, the degree of concentration of the permanganate will be different, and the results will not be comparable. Such discrepancies are largely corrected, it is true, when the distillation is carried nearly to dryness as hereafter directed, but the fact that a larger number of distillates is taken increases, on the other hand, the chance of loss of ammonia by imperfect condensation.

The end of the distillation, or the point at which the collection of albuminoid ammonia is to be stopped, should also be prescribed. The writer prefers the point of approximate dryness as the uniform stopping point in all analyses, and by this is meant the point at which the residue in the retort is reduced to less than the volume of one distillate as measured by the Nessler tubes in use. It is quite safe, either as regards spurting of the liquid or fracture of the retort, to run the liquid down to 5-7 c.c. when 100 c.c. are used, or to 20-35 c.c. when 500 c.c. are taken for analysis, provided that the flame is turned down as the volume of liquid is reduced, and

this is necessary at any rate in regulating the time of distillation as above mentioned. Each sample is thus submitted for a long time to the action of the slowly concentrating reagent, and is violently attacked at the last by the same in its strongest and hottest condition. Experience shows that there is always an increased evolution of ammonia at the last with waters that retain any organic matter at all up to this point. To carry the operation further by filling up the retort with ammonia-free distilled water is tedious, and for many reasons impracticable, and it is questionable whether any conclusion can be reached in this way that will permit a closer comparison of waters as to their organic pollution than by the method just given. The quantity of ammonia obtained at each successive refilling is generally very small, and many repetitions may be necessary. Small and frequent additions only can give to the organic matter present a repetition of the conditions obtained at the close of the first distillation, that is, heat and high concentration of the reagent, as all weaker attacks have already been successfully resisted by this matter. Repeated operations also involve, from several sources, an accumulation of small errors, which tends in time to counterbalance the increased accuracy which they aim to secure. The limit of distillation above suggested is a simple and practicable one, it involves no break in the regular course of the distillation, and offers, it is believed, the best approach to uniformity of treatment for all samples of water.

One other point which is closely connected with the foregoing should be fixed as a condition of the process, namely, the preliminary distillation by which the retort is freed from ammonia. Wanklyn's direction to use ordinary water, distilling with alkaline permanganate and then rinsing the retort before introducing the sample, is tedious and unnecessary besides involving much handling of a hot retort. The writer has long used the following method of manipulation which is free from the objections mentioned and has the advantage of being uniform and precise. The retort is rinsed with strong HCl and a fragment of sodium hyposulphite to remove the residue of a previous analysis (or boiled with a mixture of bichromate and sulphuric acid if it be a new retort or one previously used for any other purpose) washed, and rinsed with distilled water. The drawn out neck of the retort enters the tube of the condenser to a depth of at

least two inches, and a wide rubber tube, which remains stationary on the condenser, closes the junction as the retort is put in place. A stout ring of rubber (umbrella ring), which slips over the rubber tube, is used to secure the latter upon the neck of the retort when it becomes loose through use. Into the retort are put a few grains of previously ignited pumice,* 2 c.c. of a saturated solution of fused sodium carbonate and 100 c.c. of ordinary distilled water. 85 c.c. are distilled off rapidly into a flask holding that volume to a mark on the neck, and 10 c.c. into a Nessler tube, the latter being tested for ammonia. The residue in the retort should then be from 4 to 7 c.c. This preliminary operation furnishes, incidentally, a good test of the condensation. The retort being shown to be free from ammonia, 100 c.c. of the water to be tested is introduced and distilled to approximate dryness under the conditions hereafter given. The possible objection to the procedure just given is that the residue of the distilled water may contribute something to disturb the result. As to this it is plain that free ammonia is out of the question and the absence of albuminoid ammonia can be shown by an occasional analysis in blank, remembering in this case that any trace of albuminoid ammonia obtained represents twice what would occur in an analysis, as two portions of 100 c.c. each will be used. In practice, if distilled water be free from sediment and dust, no disturbance of the analysis is to be feared from this source. The above directions apply to the use of 100 c.c. for analysis. If the older, or 500 c.c. method, be preferred the quantities are proportionally increased except that 200 c.c. of water suffice for the preliminary operation.

The use of 100 c.c. instead of 500 c.c. was recommended by Wanklyn long ago and the same directions appear in later editions of his water analysis. It is much to be regretted that its use has not become general to the exclusion of the older (500 c.c.) method. It is at once more simple, more accurate and more economical of time and material than the latter. It is evident that the estimation of a given weight of ammonia by the Nessler test in a column of liquid 10 c.m. in depth for a volume of 10 c.c. must be

* This pumice is prepared in quantity by breaking it, and sorting to a size of $\frac{1}{16}$ inch, free from dust. It is ignited for ten minutes at a red heat, in a platinum dish, and kept in a tightly stoppered, wide mouth bottle.

more accurate than the estimation of five times that weight in a column of 15 c.m. in depth for a volume of 50 c.c. In practice it is less difficult to detect .0005 of ammonia in a 10 c.c. tube than .005 of ammonia in a 50 c.c. tube. The smaller tubes, moreover, are more convenient to handle, less liable to break and far less costly. Not the least advantage of the 100 c.c. method is the saving which it effects in the use of that peculiar reagent—troublesome to prepare and difficult to keep—ammonia-free water. The testimony of chemists who have tried both methods is entirely in favor of the smaller volume. The writer has used the 100 c.c. method in more than five hundred analyses.

With regard to the plan of distilling to approximate dryness in the determination of albuminoid ammonia, it may be asked whether results obtained in this way are in any sense comparable with those obtained by following Wanklyn's directions. These directions, as has already been said, are misleading so far as the 500 c.c. method is concerned, and results obtained by them will not be comparable among themselves. To distil to the point at which the evolution of ammonia appears to cease, may also be misleading in some cases, unless that point corresponds with great reduction of volume of liquid in the retort. The proposed method yields results which compare much better among themselves, and quite as well with the latter in general, as these latter compare with one another. The writer has found from a study of twenty-four analyses that the yield of albuminoid ammonia (from Croton water) between the third distillate and the point of approximate dryness was, on an average, one-third of that yielded in the first three distillates. The required correction would be much less than this amount where the distillation was carried to entire disappearance of ammonia, as is commonly done.

The modifications of the Wanklyn process suggested above may be summarized in the following plan, by which it is believed that many of the uncertainties of that process may be eliminated.

1st. Into a glass stoppered, half litre retort put 100 c.c. of distilled water, 2 c.c. of saturated solution of fused sodium carbonate and a few fragments of previously ignited pumice.* Distil off rapidly 85 c.c. into a flask, and reject; collect the following 10 c.c. and nesslerize.

2d. Add 100 c.c. of the water to be tested, collect 4 portions of 10 c.c. each for free ammonia and nesslerize each. Each distillate should be allowed ten minutes to collect.

3d. Put 11 c.c. of alkaline permanganate* solution into a small beaker, having a file mark on its side, representing 16 c.c., and another mark for 11 c.c. Add ammonia-free water to the upper mark, and boil down to the lower mark; then transfer the hot liquid through a long-necked funnel to the retort. Distil off seven portions, allowing 10 minutes for each distillate, and lowering the flame occasionally as the volume of liquid is reduced. The operation is then finished, and 4-7 c.c. should remain in the retort.

The weak standard solution of ammonia and the Nessler reagent are delivered respectively from glass stoppered burettes, one measuring to $\frac{1}{20}$ (.05) c.c., the other to $\frac{1}{2}$ c.c.

The directions apply equally well to the 500 c.c. method except, as already stated, that 200 c.c. only of water are used for the preliminary distillation and that twenty minutes instead of ten are given to the collection of each distillate.

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* The alkaline permanganate solution is made with ordinary distilled water, and is boiled down in preparation from 1500 c.c. to one litre, 500 c.c. of water in excess being added at first. The volume of 11 c.c. is used in order that 1 c.c. may be allowed for drainage, etc. The volume quickly delivered into the retort is then little over 10 c.c. This portion is prepared during the collection of free ammonia, and the distillation is only interrupted for a moment in introducing it.

ABSTRACTS.

ORGANIC CHEMISTRY.

Boiling Points and Specific Volumes of the Ethereal Salts of the Normal Fatty Acids. R. GARTENMEISTER.

The author has prepared the formiates, acetates, propionates butyrates, valerates, caproates, heptylates and octylates of the radicals methyl to octyl inclusive, also methyl nonylate; he has determined in addition the boiling point at 760 m. m. (corr.), specific gravity at boiling point and at 0°, also volume at boiling point and specific volume, and from these data deduces the following conclusions:

1. The difference between the boiling points of the methyl and octyl salts of the same acid diminishes as the acid grows richer in carbon, and the difference between the boiling points of a formiate and an octylate of the same alcoholic radicle decreases with an increase of carbon in the alcohols.

As a rule, formiates have a higher boiling point than the metameric methyl salts. The acetates boil at a higher temperature than the metameric ethyl salts. The difference between the boiling point of an acetate and a formiate is greater than that between the methylic and ethylic salt. Generally, in the case of metameric ethers, the highest boiling point corresponds to the greatest density. The formiates are an exception to this rule. The difference between the specific volume of the methyl and octyl salt of the same acid and the difference between the formiate and octylate of the same alcohol increases with the number of carbon atoms.

The results of the author are directly opposed to those of Schiff (Jour. Chem. Soc., 1883, 1044), while Stödel (Ibid., 302) in his statement that in a group of isomerides, the substance with the lowest boiling point will have the greatest specific volume, is confirmed by the author except in the case of the formiates.

As regards expansion, the author finds that the formiates show the least expansion. They are followed by the methyl salts. The acetates expand a little less than the ethyl salts. As a rule those ethereal salts having the highest boiling points show the lowest rates of expansion. (*Liebeg's Annalen*, **233**, *249*.) R. W. M.

On the Toxic Effects of the Lower Fatty Acids. H. MAYER.

For the purpose of these researches injections partly intra-venous and partly sub-cutaneous were made of the sodium salts, which had been made slightly alkaline with acid sodium carbonate. Preliminary experiments showed that an injection of a neutral salt (NaCl) in very concentrated solution (29%) produced death accompanied by cramps, while the 10 per cent. solution in doses of less than two grammes per kilogramme could be injected without injury. The sodium salt of acetic acid is not more poisonous than sodium chloride, while the corresponding salt of butyric acid has a strong paralyzing action. In cats, which show the influence of salts more distinctly and constantly than puppies, sub-cutaneous injections of the sodium salts of formic, proprionic, butyric and valeric acids caused drowsiness and coma, even in quantities in which the acetates and lactates are as indifferent as common salt. In general the action of the salt increases with each additional atom of carbon, with an exception in the case of formic acid whose effect is between that of butyric and valeric acid. (*Arch. f. exp. Path.*, **21**, *219.*) R. W. M.

Fluidity of Absolute and Diluted Acetic Acid. K. NOACK.

The author uses the formula $F=\frac{F'+F'^2\,v\,s}{2^{10}/_3\,\pi\,1\,z}$ for the flow of liquids through capillary tubes where F= corrected and F′ the uncorrected fluidity, v the volume of liquid passed, s its specific gravity and z the time of flow. The influence of temperature is greatest with water and decreases on addition of acid. A minimum of fluidity is found with 77% acid. (*Ann. Phys. Chem.*, **27**, **28**, *666.*) R. W. M.

The Non-acid Components of Beeswax. F. SCHWALB.

The examination of this substance showed that besides the higher fatty acids and alcohols, hydrocarbons were also present. From the non-acid portion, more soluble in petroleum ether, were isolated two hydrocarbons melting at 60.5° and 68° respectively, which from all appearances were identical with the normal heptacosan $C_{27}H_{56}$ and normal hentriacontan $C_{31}H_{64}$ of Krafft.

From the portion more difficultly soluble in petroleum ether, there were separated an alcohol with a melting point of 85°–85.5°, probably of the composition $C_{31}H_{64}O$, which on heating with soda lime, yields the acid $C_{31}H_{62}O_2$, melting at 88.5°–89° and soluble with difficulty in hot methyl alcohol, dilute ethyl alcohol and a mixture of ether and alcohol.

Ceryl alcohol ($C_{27}H_{56}O$ or $C_{26}H_{54}O$), the acid from which $C_{27}H_{54}O_2$ or $C_{26}H_{52}O_2$ melts at 78.5°, is also found as well as an alcohol $C_{25}H_{52}O$ or $C_{24}H_{50}O$ yielding an acid $C_{25}H_{50}O_2$ or $C_{24}H_{48}O_2$ melting at 75.5°. (*Liebig. Ann.*, **235**, *106.*) R. W. M.

On Linoleic Acid. KARL PETERS.

The author found the composition of linoleic acid, the barium salt of which, in order to avoid decomposition, he prepared by crystallizing but once from ether and then dissolving in cold ether and separating with dilute acid, to correspond with the formula $C_{18}H_{32}O_2$ instead of $C_{16}H_{28}O_2$.

This formula is proved by the fact that the linoleic acid, digested for eight to ten hours at 200°–210° with an equal volume of hydriodic acid (boiling point 127°) and five grammes of amorphous phosphorus, is converted into an acid, which after freeing from the last traces of iodine by means of sodium amalgam, melts at 69°, and corresponds with the formula of stearic acid $C_{18}H_{36}O_2$. The barium salt of linoleic acid also corresponds with the formula $(C_{18}H_{31}O_2)$ Ba. (*Monatsh. f. Chem.*, **7**, *552.*) R. W. M.

On the Influence of Carbohydrates and Fatty Bodies on the Putrefaction of Albumen. A. HIRSCHLER.

One hundred cubic centimeters of aqueous meat extract were mixed with an equal amount of pancreas extract, 200 c.c. of water and ten grammes of calcium carbonate. The whole was then digested for three to six days at 30°, when a third of the fluid was distilled off and the distillate tested for indol, skatol and phenols. To the remainder sulphuric acid was added and the ether extract tested with Millon's reagent for oxyacids. Sixteen grammes of cane sugar, eight grammes of glycerine, eight grammes of dextrin or starch added to the above mixture prevented completely the formation of

aromatic putrefaction products. Eight grammes of calcium lactate had the same effect, while emulsified olive oil, calcium malate, tartrate and citrate and sodium tartrate had no effect. (*Zeit. f. physiol. Chem.*, **10**, *306.*) R. W .M.

Production of a Gray Color on the Fibre by Simultaneous Oxidation of Aromatic Mono- and Diamines. MONNET. Y. COS.

The patent indicates production of grays with blue or brown shades by molecular mixtures of paraphenylenediamine with aniline, with toluidine, with mixtures of aniline and toluidine, etc. For example: paraphenylenediamine hydrochloride 58.3 parts, aniline hydrochloride 41.7. This mixture printed with an oxidizing agent gives a solid, bluish black.

For dyeing on cotton a similar mixture of salts is taken, 4 to 6 kilos., according to shade; for 900 kilos. of cotton add sufficient water at 60° Cent. containing 2 kilos. of potassium chlorate and 40 grms. vanadium chloride. (*Mon. de la Teinture*, *XXX.*, **23**, *272.*) M. L.

ANALYTICAL CHEMISTRY.

Detection of Peptones in Blood and Urine. M. GEORGES.

The author considers all of the existing processes defective; he employs the two following:

1. Wassermann's process for the detection of peptones in blood. Pour the blood into strong alcohol; filter and evaporate the alcoholic solution. The coagulum produced by the alcohol is washed with cold water, then with boiling water; the solutions are concentrated and added to the alcoholic residue. The latter is treated with a mixture of sodium acetate and ferric chloride after neutralizing with excess of alkali. Filter and separate the last traces of albumen by potassium ferrocyanide and acetic acid; filter again and precipitate excess of ferrocyanide with cupric acetate; filter again and treat with H_2S; filter finally and concentrate on the water-bath.

2. The treatment for urine begins by a precipitation of albumen by heat, based upon the insolubility of the albuminoid precipitate with potassio-mercuric iodide in acetic acid; in applying this method

to urine treat this liquid with the double iodide and acetic acid after elimination of albumen by heat. The precipitate is collected and washed on the filter with cold water acidulated with acetic acid; then washed with boiling water. The liquid of this second washing is collected separately. If the solution contained peptones, a precipitate will appear on cooling. The reaction of Piotromski (addition of a solution of copper sulphate and a few drops of caustic potash) can be tried on the neutralized liquids. The characteristic coloration is rose with a violet-blue tinge. (*Arch. de Pharm.*, **1**, *534.*) M. L.

On the Elaidin Reaction. FINKENER.

If to 10 c.c. of olive oil is added 1 c.c. of nitric acid (sp. gr. 1.4) and 0.4 grm. of copper foil, and the same is shaken for one half minute, the red vapors are dissolved and the oil when cooled to 10°–12° solidifies within 30 minutes to a perfectly solid mass. If mercury is used instead of copper, the solidification is slower. If sulphuric acid (sp. gr. 1.53) is used and a concentrated solution of potassium nitrate, the same red vapors are given off dissolving on shaking, but when the oil is subsequently cooled to 10°, no solidification takes place even after 24 hours. If nitric acid (sp. gr. 1.2) is used and potassium nitrate the oil begins to solidify after 12 hours. Nitric acid (sp. gr. 1.4) and potassium nitrate produces solidification after three hours. Nitric acid of the same strength alone does not cause the oil to solidify. A mixture of equal volumes of fuming sulphuric acid and water causes solidification in four hours. If nitric fumes are passed through the oil, the solidification begins after several hours.

Besides olive oil, peanut oil treated in the same way with nitric acid and copper, solidifies, but poppy and linseed oils do not; sesame oil, after 75 minutes at 10°, becomes as solid as soft butter. (*Mitth. aus. den. Kgl. Versuchsanst, 1886, 113.*) R. W. M.

Milk-testing for Addition of Water. SOXHLET.

100 c.c. of milk are boiled with 1.5 c.c. of a 5% solution of calcium chloride. A small portion of the filtrate is treated with sulphuric acid in which 2% of diphenylamine is dissolved. When this mixture is spread over concentrated sulphuric acid, the

presence of acids containing nitrogen is indicated by a blue line at the line of contact of the two liquids.

The following process is much more delicate: 450 c.c. of milk are boiled with 6–7 c.c. of a 20% solution of calcium chloride, the filtrate (about 300 c.c.) treated with 2 c.c. concentrated sulphuric acid and 120–150 c.c. distilled off. The distillate made feebly alkaline with soda is evaporated down to 5 c.c. in a platinum capsule and tested as above. (*Repert. der anal. Chem.*, *1886*, *360.*)

R. W. M.

Examination of Soap Powders. FINKENER.

One gramme of the sample is warmed to boiling with 10–15 c.c. of a mixture of equal parts of 85% alcohol and concentrated acetic acid. Pure soap powder dissolves completely; foreign substances such as talc collect at the bottom, while soda, chalk, etc., are detected by the evolution of carbon dioxide. If the clear layer is treated with water, the fatty separates out on the surface. (*Mitth. aus den Kgl. techn. Versuchsanst*, *1886*, *113.*) R. W. M.

Addition of Goat's Milk to Cow's Milk. N. GERBER.

This addition is not indicated either by the specific gravity or the per cent. of fat. The cream, however, does not rise on goat's milk and the presence of it in cow's milk causes much of the cream of the latter from rising. Even 10% will considerably diminish the amount of cream. (*Bied. Centrbl.*, *1886*, *419.*) R. W. M.

Detection of Cinchonidine in Quinine Sulphate. DE VRIJ.

The process is based on the great insolubility of quinine chromate.

Take 1 grm. of quinine sulphate, dissolve in 100 c.c. distilled water. To the solution add 0.240 grm. of pure, neutral potassium chromate and allow to settle over night; the yellow chromate deposits; filter and the cinchonidine remains in solution. If no turbidity appears when caustic soda is added to the solution, no cinchonidine is present. If a turbidity appears the proportion of cinchonidine sulphate is estimated to be 5%. To collect the cinchonidine two-fifths of the solution must be evaporated, and it is better then to operate on 5 grms. of salt. The author considers the process of irreproachable accuracy. (*Arch. de Pharm.*, **1**, *548.*)

M. L.

Abstracts of American Patents Relating to Chemistry.

(*From the Official Bulletin of the U. S. Patent Office.*)

July 27th, 1886.

346,114.—Manufacture of white pigments. Geo. T. Lewis.

346,143.—Compound for coating and finishing walls. E. A. Bronson.

Consists of plaster of paris, sand, glue, whiting or Keene's cement, marble dust, and a suitable coloring matter.

346,150.—Waterproof composition for felt shoes, slippers, etc. J. Feldmann, C. H. Feldmann, and D. Dunbar.

Consists of caoutchouc, magnesia, wheat flour, sulphur, zinc oxide, alum and lamp black.

346,168.—Apparatus for manufacturing lamp black. J. J. McTighe.

346,169.—Manufacturing carbon black. J. J. McTighe.

Hydrocarbon vapor is subjected to intense heat, without combustion, so as to dissociate the gases, and the dissociated vapors are cooled to deposit the carbon black.

346,258.—Process of electro depositing nickel. E. C. Bates.

346,301.—Gas retort furnace. G. A. McIlhenny.

346,304.—Water filter. A. McLean and F. Cumming.

346,336.—Mixed paint. F. Wendling.

Consists of potassium silicate, calcium "fluoxide," cryolite, marble, basic calcium carbonate, and calcium phosphate.

346,448.—Process of extracting paraffine from petroleum distillate. C. Vose.

Aug. 3d, 1886.

346,461.—Soap compound. C. F. Broadbent.

Consists of white borax chips, sodium hyposulphite and French chalk.

346,525.—Making hydraulic cement. J. Anderson.

Ordinary cement or limestone rock is immersed in a solution of acetic acid and then calcined.

346,581.—Composition for preserving leather. E. Z. Coffee.

Consists of water, gambier, Glauber's salt, beef suet, concentrated lye and crude coal oil.

346,729.—Artificial stone. H. A. Daniels.

Consists of sand, cement, and a solution of caoutchouc or non-friable binding material.

346,730.—Artificial stone. H. A. Daniels.

Consists of sand, cement, caoutchouc and an alkali.

346,731.—Artificial stone. H. A. Daniels.

Consists of sand, cement, glue, pearl ash, alum, coloring matter and gallic acid.

346,732.—Artificial stone. H. A. Daniels.

Consists of sand, cement, caoutchouc and sodium chloride.

346,733.—Artificial stone. H. A. Daniels.

Consists of sand, cement, a binding agent, as glue, and vitriol.

346,736.—Manufacture of artificial stone. H. A. Daniels.

Articles formed of artificial stone composition are subjected to vapor arising from alum.

346,765.—Compound for increasing combustion of coal, etc. J. S. McIntire.

Consists of common salt, sodium sulphate, sodium bicarbonate, sodium nitrate, ammonium carbonate, zinc, sulphate, borax, resin and charcoal.

346,768.—Manufacture of whiting. J. Quinn, Jr.

Consists of pulverized chalk, produced from calcined ground gypsum which has been previously set and hardened.

346,803.—Carbureting compound. F. W. Burk.

Consists of benzine, vegetable wax and gum camphor.

346,820.—Process of preparing starch. G. Luthy.

Aug. 10th, 1886.

346,940.—Apparatus for carbureting gas. W. F. H. O'Keefe.

346,973.—Apparatus for manufacturing lamp black. J. Wilson.

347,078.—Compound for perfecting the combustion of coal or other fuel. G. White.

Consists of sodium chloride, sodium sulphate, lime, cement, plaster, charcoal, or any other similar absorbent, and water.

347,164.—Manufacture of incandescents. A. de Lodyguine.

Carbons are prepared from organic substances containing the elements of water, by treating the organic substances with boron fluoride.

Aug. 17th, 1886.

347,345.—Refining vegetable oils. A. T. Hall.

The oils are treated with sulphuric acid while held in solution in hydrocarbon spirit or other solvent.

347,349.—Process of dephosphorizing iron by means of fluorine. J. Henderson.

The molten iron is treated with some compound of fluorine.

347, 367.—Hydraulic cement. J. Murphy and N. W. Lord.

Consists of limestone, furnace slag, salt and clay, which ingredients are mixed, burned, and then reduced to powder.

347,381.—Vacuum evaporator for saccharine and gelatinous liquids, milk, etc. N. B. Rice.

347,424.—Dynamite. M. Eissler.

Consists of coated granules of nitrates, nitro-cellulose, and nitro-glycerine, combined with rye flour.

347,525.—Process of preparing paper for sun pictures. J. S. Simonds.

347,611.—Method of manufacturing malt liquors from starch. W. T. Jebb.

347,612.—Method of manufacturing malt liquors from starch. W. T. Jebb.

347,663.—Apparatus for carbureting gas. J. S. Tibbets.

347,693.—Process of decomposing and carbureting natural gas. J. M. Critchlow.

347,731.—Process of making alcohol. C. Ordouneau.

August 24th, 1886.

348,165.—Process of bleaching mechanical wood pulp and other vegetable fibres for the purpose of manufacturing paper. C. J. A. Just, F. A. Fletcher and C. F. Gibbs.

The process consists of the following steps: first, treating the pulp or fibre with an emulsion composed of a mineral oil and an alkaline oxidizing agent; second, adding common salt; third, adding an acid or its specified equivalent; and fourth, treating the resulting product with an oxidizing or bleaching agent.

348,178.—Process of and apparatus for manufacturing heating gas. A. W. Wilkinson.

August 31st, 1886.

348,348.—Process of producing chlorine. G. Rumpf.

Vapors containing ammonium chloride are passed over manganese oxide, and the resulting manganese chloride is decomposed by passing air over it.

348,391.—Wire coating compound. E. L. Gates.

A composition for coating wire, previous to drawing, consisting of flour and a solution of sodium carbonate.

348,415.—Manufacture of artificial stone. F. Reimers.

Composed of sand or gravel and cement, or of pulverized gypsum, united and solidified by mixing with a solution of water, bittern water, caoutchouc dissolved in naptha, sodium carbonate, gum arabic, magnesia, zinc chloride and ferric oxide.

348,483.—Production of phenylmethyloxyquinicine. H. von Perger.

Produced by the action of hydrazobenzene upon acetylacetic ether.

September 7th, 1886.

348,613.—Manufacture of yellow coloring matter or dyestuff from gallic acid. R. Bohn.

348,816.—Resorcin-blue compound. H. M. Baker.

The compound is prepared by making a solution of resorcin in an excess of ammonium hydrate, agitating the resulting solution by the alternate, or intermittent immersion therein of a copper plate, adding dilute acid in excess, boiling and filtering.

348,832.—Apparatus for the purification of gas. A. Delaney and W. Simpkin.

348,904.—Apparatus for cooling oil to extract paraffin, etc. N. McF. Henderson.

348,917.—Carburetor to be used in the manufacture of water gas. F. C. Kniese.

September 14th, 1886.

348,993.—Rendering animal and vegetable fibre water proof, etc. T. J. Pearce and M. W. Beardsley.

The material is treated with a compound of carbon disulphide and maltha.

348,994.—Insulating wire and conductor for electrical purposes. T. J. Pearce and M. W. Beardsley.

The wire is coated with a solution of maltha in carbon disulphide.

349,172.—Composition for waterproofing and preserving. R. E. Nichols.

Consists of creosote, paraffin wax, paraffin oil, benzine, napthalene and a fluid hydrocarbon.

349,211.—Method of and apparatus for carbureting and mixing gas and air. G. R. Cottrell.

349,228.—Apparatus for making and burning gaseous fuel. J. Locke and S. O. Richardson.

349,241.—Apparatus for making sulphuric acid. J. J. Thyss.

September 21st, 1886.

349,304.—Composition for streets, sidewalks, etc. T. Egan.

Consists of pitch, stone, gravel, sand, cement, cinder, sulphur, air slaked lime, salt and tar.

349,414.—Pan for concentrating sulphuric acid. K. J. Sundstroem.

349,449.—Process and apparatus for distilling. J. C. Peden.

349,574.—Process of preserving milk. R. Ellin.

Milk is mixed with sugar and evaporated to dryness below 140° F

345,589.—Tanning process. G. W. Hersey.

The process consists, first, in placing the hides in a liquor consisting of lye and salt; second, adding ashes or bran until the hair starts; third, adding more bran; fourth, placing the hide in a liquor consisting of salt, alum, borax, saccharine matter, French ochre and water.

349,658.—Process of and apparatus for washing, decoloring and draining pyroxylin. G. M. Mowbray.

Pyroxylin is decolorized by treating with oxalic acid and hydrochloric acid, or with an acid oxalate.

349,659.—Method of drying pyroxylin. G. M. Mowbray.

September 28th, 1886.

349,744.—Process of dephosphorizing iron by means of oxides of iron. J. Reese.

349,751.—Composition of matter for packing the joints of gas pipes. A. H. Rowland and R. S. Hunzeker.

Consists of tar and molasses, or other saccharine matter.

349,760.—Algin and other useful products. E. C. C. Stanford.

Sea weeds are treated with solution of sodium carbonate, and the algin is precipitated by an acid.

349,852.—Preservation of meat. C. Marchand.

Meat is immersed in a solution of hydrogen peroxide under pressure.

349,885.—Manufacture of paint. G. W. Holley.

Mineral oxides, earths and other pigments are combined with one-half to one-tenth their weight of finely pulverized sulphur and linseed oil.

349,900.—Composition for preserving food. W. Radam.

A fumigating composition, consisting of sulphur, sodium nitrate, manganese dioxide, sandal wood and potassium chloride.

348,981.—Obtaining sulphur from hydrogen sulphide. C. F. Claus.

Hydrogen sulphide is decomposed by contact with anhydrous oxide of iron heated to 200° F.

350,012.—Production of salol. M. W. Nencski.

Produced by the action of phosphorous oxychloride upon a mixture of salicylic acid and phenol.

October 5th, 1886.

350,148.—Extracting zinc from its ores by means of gases. C. H. Murray.

A process for distilling zinc from its ores, effecting its distillation by forcing through such ores superheated reducing gases, which gases are prevented from burning with fresh air or free oxygen at any stage of the operation, either before or after they have entered the ore retort, and by pressure and the imposed high temperature, in combination with said reducing gases, effecting the reduction, distillation, and condensation of the metal, in one operation.

350,170.—Bone black revivifier. J. F. Stillman.

350,218.—Bleaching compound. C. Toppan.

Consists of expressed oil of mustard seed, paraffin, sodium hydroxide, tallow soap, sodium sulphate and water.

350,229.—Yellow coloring matter. F. Bender.

Produced by treating the soda salt of a paranitrotoluolsulpho-acid with sodium hydroxide, reducing the resulting red product to an amido-sulpho acid, diazotizing the latter, and combining the diazo-compound with a mixture of phenol and its carbon acids, or with only one of the ingredients of the said mixture.

350,230.—Red coloring matter. F. Bender.

Produced by treating the soda salt of a paranitrotoluolmonosulpho acid with sodium hydroxide, reducing the product to an amidosulpho acid, diazotizing the latter, and combining the diazo-product with betanaphthylamine hydrochloride and a sodium salt of betanaphthylaminesulpho acid, or with either.

350,270.—Vacuum ice making machine. H. Pischon and R. Pfennig.

350,297.—Protective coating for the electrodes of batteries. L. A. W. Desruelles.

Consists of a fatty substance mixed with mercury.

350,382.—Carburetor. J. D. Merritt.

350,468.—Manufacture of naphthol-carbonic alkaline salts. R. Schmitt and C. Kolbe.

Carbonaphthol-acid salts are produced by the action of carbon dioxide upon the alkali salts of alpha- or beta-naphthol under pressure at a temperature of 120–145° C.

October 12th, 1886.

350,497.—Manufacture of pyroxylin. G. M. Mowbray.

350,498.—Manufacture of pyroxylin. G. M. Mowbray.

The use of steeled cast iron pots for holding the mixed acids in which the cellulose is immersed.

350,679.—Apparatus for purifying water. J. W. Hyatt.

350,680.—Coagulant for purifying water. J. W. Hyatt.

350,706.—Composition for tanning. M. Sutherland.

Consists of water, extract of cockleburr, terra japonica, extract of hemlock, and sulphuric acid.

350,765.—Paint. J. H. Palmer.

Consists of the residuum of linseed oil (from the purification of such oil) combined with linseed oil.

350,849.—Apparatus for mixing atmospheric air with natural gas. W. Snee

October 19th, 1886.

350,911.—Composition of matter to be used for journal boxes. F. J Coburn and E. M. Dean.

Consists of asbestus, plumbago, mica, talc, soapstone, sodium carbonate, litharge, mineral magnesia, and a cementing substance.

350,919.—Lining for converters and furnaces. W. L. Dudley.

Consists of aluminium oxide, ferric oxide and fire clay.

350,920.—Lining for converters and furnaces. W. L. Dudley.

Consists of chrome iron ore, fire clay and carbonaceous material.

350,921.—Lining for converters and furnaces. W. L. Dudley.

Consists of aluminium oxide and viscous carbonaceous material.

350,922.—Lining for converters and furnaces. W. L. Dudley.

Consists of aluminium oxide and chrome or titanium iron ore.

350,999.—Evaporating pan for salt, etc. G. H. Smith.

351,056.—Production of betanaphtholdisulpho-acids. F. Krueger.

Concentrated sulphuric acid is heated above the melting point of betanaphthol, and after introducing the betanaphthol, the temperature is maintained at 125–145° C. for four to five hours. The resulting betanaphtholdisulpho-acid is separated by treating its acid or neutral soda or lime salt in aqueous solution with common salt.

351,069.—Bleaching wood and other material. G. H. Pond.

A bath of calcium sulphite is decomposed with sulphuric acid, thereby freeing the sulphurous acid, and developing oxygen, which, in conjunction with the free sulphurous acid, partially bleaches the pulp.

351,082.—Manufacture of salt. H. Williams, J. L. Alberger, and L. R Alberger.

351,184.—Producing anhydrous aluminium chloride. C. F. Mabery.

Hydrochloric acid gas is passed over an aluminium alloy heated to 200–300° C., and the resulting aluminium chloride is condensed.

351,195.—Lubricating compound. D. L. McKenzie.

Consists of animal fat, mineral oil refuse, slaked lime, and manganese.

351,204.—Tanning process. J. T. Rhyne.

351,210.—Sizing material for papermakers' use. C. Semper.

351,330.—Lining for digestors. A. D. Little.

Consists of oxide and borate of lead.

October 26th, 1886.

351,352.—Process of forming oil from kerosene and tallow for lubricating. A. Andrews and D. E. Andrews.

One part of melted tallow is mixed with four parts hot kerosene oil and heated to boiling.

351,380.—Mixed paint. O. Kall.

Consists of blood containing fibrin, slaked lime, potassium permanganate, and lavender.

351,412.—Process of obtaining ammonia and illuminating gas from tank waters. J. Van Ruymbeck.

Concentrated tank waters are heated to about 500° F. and the volatile products are collected.

351,413.—Art of making glass and vitreous or porcelaneous products. J. T. Wainwright.

351,424.—Moth and disinfectant paper. W. H. H. Childs.

Consists of layers of paper and an interposed layer of naphthalene.

351,484.—Soluble laundry blue. G. W. Barlow.

Soluble blue powder mixed with glycerine.

351,607.—Process of making fish glue. W. N. Le Page.

351,611.—Compound for insulating telegraph wires, etc. R. Alexander.

Consists of asphaltum, residuum of petroleum, or crude petroleum, mineral wool or glass flock, and cement or calcium carbonate.

November 2d, 1886.

351,865.—Process of concentrating ammoniacal liquor. C. W. Isbell.

351,890.—Compound for preparing starch or flour size for yarn, textile, or other fabrics. C. N. Waite.

351,929.—Bone black drier. S. M. Lillie.

November 9th, 1886.

352,216.—Preserving timber. H. Aitkin.

The outer surface of the timber is saturated with naphthalene.

352,236.—Process of mordanting. B. Finkelstein.

Vegetable fibres, yarns, or woven goods impregnated or printed with tannin are mordanted with antimony by treating with antimony oxalate suspended in water.

352,316.—Manufacturing white lead. W. E. Harris.

Carbonate of lead is prepared by the action of sodium carbonate on lead sulphite and lead sulphate.

352,361.—Protection of acetine-blue colors. C. Schraube.
Obtained by the action of acetine on induline.

352,438.—Preparation for cleaning and polishing metals. H. A. Arndt.
Consists of oxalic acid, rotton stone, tartaric acid, table salt and water.

November 16th, 1886.

352,611.—Explosive compound. E. Du Pont.
Consists of nitrates and sulphur combined with charcoal retaining its fibrous structure.

352,613.—Process of and apparatus for generating compound gases. C. G. Fairchild.

352,615.—Process of purifying and hardening copper and copper alloys. F. M. Forman.
Copper and a carbonate are fused together, and carbonaceous material is burnt above the same.

352,620.—Manufacture of gas from crude petroleum. F. C. Kniese.

352,630.—Boiler water purifier. E. A. Russell.

352,644.—Filter. W. Foulkes and W. E. Foulkes.

352,662.—Process of and furnace for burning wet vegetable, animal or mineral matter. L. P. Rider.

352,663.—Process of burning gas. L. P. Rider.

352,726.—Manufacture of artificial leather or leather cloth. W. V. Wilson.
A fabric is coated with the residuum from a solution of mononitrocellulose in amyl acetate, mixed with oil and a coloring matter.

352,729.—Manufacture of parchmentized paper board. E. Andrews.

352,759.—Method of sizing paper. C. Kellner.
The pulp is mixed with resin soap, and the resin precipitated by a sulphite.

352,808.—Process of clarifying coffee or cocoa. S. C. Davidson.
Borax or alkali is added to faint alkaline reaction.

352,809.—Process of clarifying tea. S. C. Davidson.
Borax is added to faintly alkaline reaction.

352,852.—Insulating material for electric wires. D. Brooks, Jr.
Consists of rosin and rosin oil.

352,889.—Composition of matter for fuel. H. Prinzhorn.
Consists of charcoal, sodium nitrate, potassium nitrate, or other soluble hyperoxide, glue, dextrin, gum arabic, or other adhesive material, clay and iron filings.

November 23d, 1886.

352,943.—Water purifying apparatus. J. H. Blessing.

352,944.—Apparatus for purifying water. J. H. Blessing.

352,945.—Compound for coating wood, cordage, etc. T. B. Boscher.
Consists of water, gas tar, dead oil, pine tar, naphtha, ammonium chloride, and bone black.

353,092.—Refining raw colored sugars. C. Steffer.
The sugar is lixiviated with an aqueous solution of pure sugar.

353,112.—Welding compound. J. O. Ball.
Consists of zinc oxide and sand.

353,207.—Water filter. W. H. Cummings.

353,210.—Fertilizer. D. W. Dudley.
Equal quantities of bone meal and wood ashes are saturated with water and allowed to remain in such condition for about three weeks, then lime is slaked in brine and added to the mixture; finally salt and gypsum in equal quantities are added to the mass.

353,222.—Apparatus for making sulphuric acid. J. Hughes.

353,247.—Process of making steel. D. Brose.
Manganese and calcium carbonate are added to the refined metal, at or near the same time.

353,264.—Manufacture of sulphonated purple dyestuffs from basic rosaniline. C. L. Müeller.

353,265.—Manufacture of sulphonated purple dyestuffs from basic rosaniline. C. L. Müeller.
Obtained by the condensation of tetraethyldiamidobenzophenone with benzyldiphenylamine and toluol.

353,266.—Manufacture of sulphonated purple dyestuffs from basic rosaniline. C. L. Müeller.

November 30th, 1886.

353,311.—Carburetor. P. Keller.

353,341.—Compound for tanning. H. L. Wilcox.
Consists of the extracts of *polygonum* and *rhus glabrum*.

353,358.—Apparatus for oxidizing drying oils and other liquids. J. W. Hoard and T. R. Hoard.

353,362.—Process of distilling petroleum. G. H. Kline.

353,378.—Liquid for the production of cold.
Consists of liquid anhydrous sulphur trioxide and carbon dioxide.

353,404.—Method of filtering sugar liquors, sirups and saccharine juices. C. H. W. Foster.

353,468.—Process and apparatus for dissolving and removing the gum from nettle and other plant fibres. T. E. Schiefner.

353,501.—Brick. E. L. Ransome.
An unburned brick made from tufa, or tufa and lime.

353,514.—Filter Press. M. Swenson.

353,515.—Concentrating Pan. M. Swenson.

353,523.—Ornamentation of glassware. A. Witthauer.
Consists of ale, beer, epsom salts and nitre.

353,566.—Process of manufacturing soap and glycerin. M. H. Lackersteen.
Neutral fats and oils are emulsified with a solution of sodium chloride, etc., and the emulsion is subjected to electrolysis. W. R.

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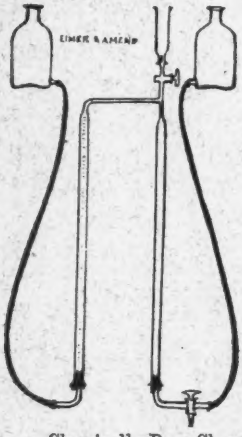

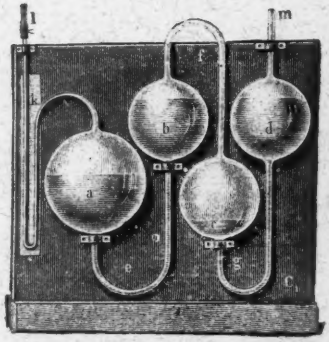

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